Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40791

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Automobile Engineering

MA 8452 — STATISTICS AND NUMERICAL METHODS

(Common to Mechanical Engineering/Mechatronics Engineering/
Production Engineering/Robotics and Automation)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write down the assumption of t test.

2. Explain test of significance of small samples.

3. State the basic principles of experiment of design.

4. State the basic designs of experiment.

5. Find by Newton's method the real positive root of $3x - \cos x - 1 = 0$ to 3 decimal places.

6. Solve by Gauss Elimination method $x + y = 2;\ 2x + 3y = 5$.

7. Using Lagrange's interpolation formula find the value of y corresponding to $x = 10$ from the following table.

x	5	6	9	11
y	12	13	14	16

8. If $F(x) = \frac{1}{x}$, find $F(a, b, c, d)$ or $\Delta^3_{bcd}\left(\frac{1}{a}\right)$.

9. By means of Taylor's series expansion, obtain approximate value of y at $x = 0.2$ for $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$.

10. Using Euler's method, find $y(0.2)$ and $y(0.4)$ if $\frac{dy}{dx} = x + y$, $y(0) = 1$ with $h = 0.2$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Test made on the breaking strength of a metal wire gave the results : 578, 572, 570, 568, 572, 570, 570, 572, 596 and 584 kgs. Test if the mean breaking strength can be assumed as 577 kg. (8)

(ii) A group of 10 rats fed on a diet A and another group of 8 rats fed on diet B were observed to have the following increase in weight.

Sample 1	5	6	8	1	12	4	3	9	6	10
Sample 2	2	3	6	8	10	1	2	8	–	–

Show that the estimates of the population variants from the samples are not significantly different. (8)

Or

(b) (i) Theory predicts the proportion of beans in 4 groups A, B, C, D should be in the ratio 9:3:3:1 in an experiment. Among 1600 beans the number in the 4 groups were 882, 313, 287, 118. Does the experiment support the theory? (8)

(ii) In a random sample of size 500, mean is found to be 20. In another independent sample of size 400, mean is 15. Could the sample have been drawn from the population with S.D. 4? (8)

12. (a) The following data resulted from an experiment to compare 3 burners B1, B2, B3. A Latin square design was used as the tests were made on 3 engines and were spread over 3 days. Perform an analysis of variance at 5% level of significance on the data. (16)

		Engine		
		1	2	3
	1	B1-16	B2-17	B3-20
Day	2	B2-16	B3-21	B1-15
	3	B3-15	B1-12	B2-13

Or

(b) The table below gives the yield of potatoes using four different treatments. Perform a 2-way classification at 5% level of significance to test whether there is a significant difference among the four treatments.

Treatments	yields (lbs per plot)			
I	23	25	22	38
II	40	26	36	38
III	29	20	30	20
IV	34	31	24	28

Analyse the data and give your conclusion. (with $\alpha = 1\%$) (16)

13. (a) (i) Solve the following equations using Gauss Jacobi iteration method (8)

$30x - 2y + 3z = 75;\ x + 17y - 2z = 48;\ x + y + 9z = 15$

(ii) Solve the system by Gauss Seidal iteration method : (8)

$20x + 4y - z = 32;\ x + 3y + 10z = 24;\ 2x + 17y + 4z = 35$

Or

(b) (i) Find the dominant Eigen value and the corresponding Eigen vector of $A = \begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$. Find also the least latent root and hence find the third Eigen value also. (8)

(ii) Solve by Gauss Jordan method $x + y + w + z = 2;$ $2x - y + 2z - w = -5;\ x + 2y + 3z + 4w = 7;\ x - 2y - 3z + 2w = 5$. (8)

14. (a) (i) Evaluate $I = \int_0^6 \frac{dx}{1+x}$ by using

(1) Direct integration,

(2) Trapezoidal

(3) Simpson's $\frac{1}{3}^{rd}$ rule. (8)

(ii) Find the first 3 derivatives of $f(x)$ at $x = 1.5$, by using Newton's forward interpolation formula from the following data : (8)

x	1.5	2	2.5	3	3.5	4
$f(x)$	3.375	7	13.625	24	38.875	59

Or

(b) (i) Find the value of $\tan 45° 15'$ using interpolation from the following table : (8)

$x°$	45	46	47	48	49	50
$\tan x°$	1	1.03553	1.07237	1.11061	1.15037	1.19175

(ii) Evaluate $\int_1^{1.4} \int_2^{2.4} \frac{dx\,dy}{xy}$ using Trapezoidal rule and Simpson's rule, also verify using actual integration. (8)

15. (a) (i) Compute $y(0.2)$ given $\frac{dy}{dx} = y - x,\ y(0) = 2$ by R-K method of 4^{th} order $h = 0.1$. (8)

(ii) Solve numerically by Milne's method $y' = \frac{1}{x + y};\ y(0) = 2$ with the initial values $y(0.2) = 2.0933;\ y(0.4) = 2.1755;\ y(0.6) = 2.2493$. (8)

Or

(b) (i) Solve $y' = y - \left(\frac{2x}{y}\right),\ y(0) = 1$ in the range $0 \le x \le 0.2$ using modified Euler's method by taking $h = 0.1$. (8)

(ii) Apply Taylor's series method, find $y(0.1)$ and $y(0.2)$ correct to three decimal places if $\frac{dy}{dx} = y^2 + x$ and $y(0) = 1$. (8)

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